

# THE WEATHER AND CIRCULATION OF SEPTEMBER 1968

## Cool Over Much of the Nation With Progression of the Long Waves

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### 1. MEAN CIRCULATION

Progression in the Pacific during August [1] continued in September across North America and the Atlantic. The Bering Sea Low of August moved to the Gulf of Alaska (fig. 1), while a ridge replaced the West Coast trough. This trough appeared in central North America and became a full latitude feature extending from the southern United States to the Low over the Arctic Basin. A strong blocking positive height anomaly formed farther to the east over Canada, while a slightly weaker positive center, that had been present during August, persisted east of Greenland (fig. 2). This block is much more evident in the anomaly pattern than in the actual 700-mb. flow, and instead of the usual southward displacement of the main band of westerlies with blocking, there was one axis

of maximum wind speed near the normal position (fig. 3) over eastern North America with a second maximum to the north and a third branch to the south over the western Atlantic.

The deep Low which had been over eastern Canada in both August and July [1, 2] moved southeastward to a position well south of normal for September giving a strong negative height anomaly center near 55°N. and 25°W. This anomaly center was part of an extensive band of below normal heights stretching from the western Atlantic to the Black Sea. At the same time, 700-mb. heights were above normal in the southeastern Atlantic, resulting in 700-mb. wind speeds that averaged over 15 m.p.s. west of the British Isles (fig. 3). One effect of this strong progressing Atlantic cyclone was the flooding rains that occurred in the British Isles during September.

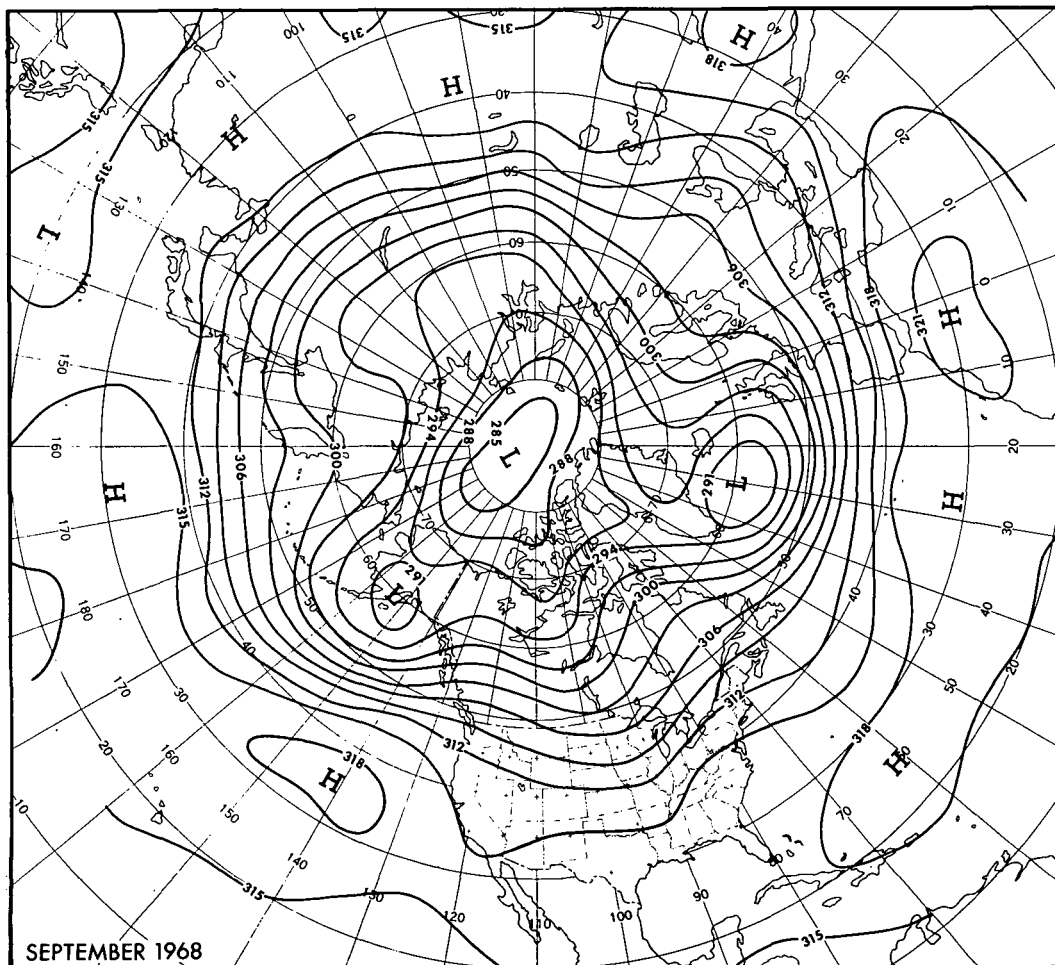


FIGURE 1.—Mean 700-mb. contours (decameters) for September 1968.

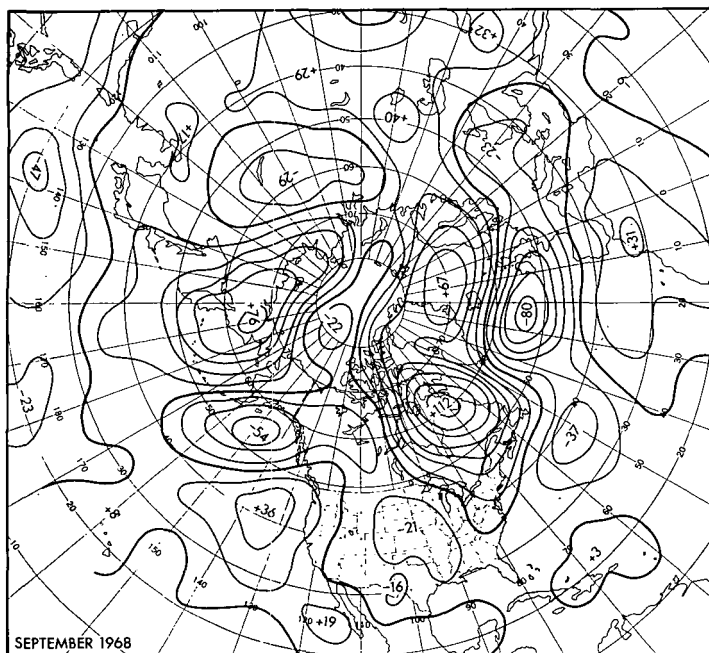


FIGURE 2.—Departure from normal of mean 700-mb. height (meters) for September 1968.

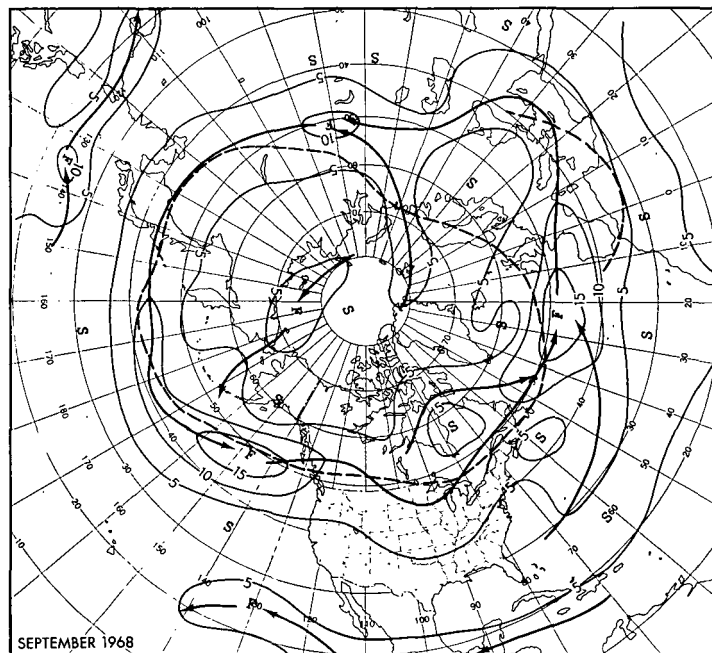


FIGURE 3.—Mean 700-mb. isotachs (meters per second) for September 1968. Solid arrows indicate the observed axes of maximum wind speed and dashed lines the normal axes.

The 700-mb. height anomaly change from August to September (fig. 4) has a pattern very similar to the height anomaly for September in the vicinity of North America. The magnitude of the changes is stronger than the anomalies in this area, illustrating a reversal of anomaly pattern between the 2 mo. This similarity between the change pattern and the anomaly pattern is evident in parts of Eurasia, especially just west of Lake Baikal in central Asia, where negative height anomaly in September replaced positive values of the previous month. However, in the European area the pattern of above normal 700-mb. heights in the north and below normal heights in the south persisted from August to September, even though anomaly changes did occur.

The Arctic Basin Low deepened as it shifted from its more favored position near Novaya Zemlya toward Alaska, but the associated negative anomaly decreased. The major reason for the anomaly decrease was that the increase in the depth of the Low was less than seasonally expected.

Heights of 700 mb. increased sharply over the northern part of the western Pacific during September (fig. 4), but decreased to the south. A very strong negative anomaly center for low latitudes developed near 20°N. and 140°E. This was related to typhoon activity in the western Pacific.

## 2. MONTHLY TEMPERATURE

The extensive north-south trough through central North America along with the blocking ridge over eastern Canada gave below normal temperatures to most of the Nation (fig. 5), continuing the prevailing cool regime of the summer. In some sections of the Country below normal temperatures have prevailed for a much longer period. Birmingham, Ala., reported the ninth consecutive month with

below normal temperatures, and at Topeka, Kans., only March of the last 17 mo. had above normal temperatures.

An average of 73.3°F. at Jackson, Miss., was 3.2°F. below normal and tied 1957 for the coolest September of record, while 72.4°F. at El Paso, Tex., was 2.6°F. below normal—the lowest September average since 1913. However, the coolness in general was not extreme through the month, and the normal September temperatures at those stations that did report much below normal were such that the result was pleasantly mild weather except in the Rocky Mountains and the Great Basin, where some freezing temperatures and snow occurred.

Above normal temperatures for September were confined to the Northeast, the Great Lakes Region, a very small section of the Far West, and most of Florida. Temperatures in the extremely warm categories were very few; and though a few daily maximum temperature records were established, no monthly high temperature records were reported.

A very large number of station reports used glowing terms to describe the weather. Boston, Mass.—a delightful month, very sunny skies; Charleston, S.C.—beautiful month weatherwise, mild, dry; Cairo, Ill.—typical September, cool gentle breezes; Youngstown, Ohio—pleasant September; Reading, Pa.—ideal weather most of month; Yuma, Ariz.—below normal temperature, 100-percent possible sunshine; Washington, D.C.—weather about perfect (author's opinion).

## 3. MONTHLY PRECIPITATION

The large-scale precipitation pattern for September in the United States was predominantly light along the East Coast and in the West with heavy precipitation over much of the Mississippi Valley (fig. 6). This is in agreement with the upper level ridges along the two coasts and

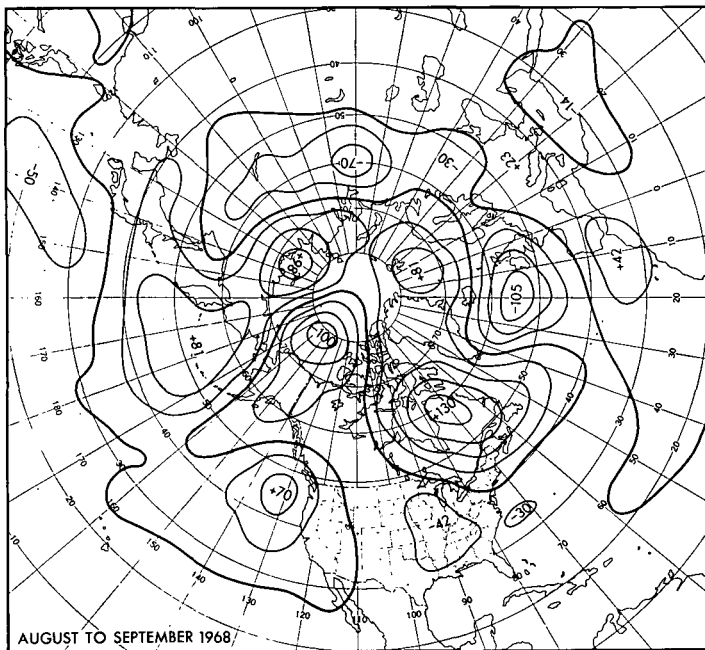


FIGURE 4.—Mean 700-mb. height anomaly change (meters) from August to September 1968.

the mean trough in the middle of the Country (fig. 1). The sections in between the major heavy and light areas, where patches of light, moderate, and heavy precipitation are intermingled, can best be explained in relation to migratory storms and will be discussed in a later section.

Few, if any, stations reported record heavy amounts of precipitation this month, but some stations reported unusually large and near record rainfalls. Marquette, Mich., reported 7.22 in., which was 3.94 in. above normal and the second largest September total since records began in 1871. Kalispell, Mont., recorded 3.33 in. which was over three times the normal (following almost three times the normal in August). After the wettest August of record, Sheridan, Wyo., received 2.12 in., which was nearly twice the September normal. Corpus Christi, Tex., reported 6.34 in. for September. This amount was about 2 in. above the normal, which is not a large excess, but it resulted in an excess of 14.6 in. for the year in that area. The Corpus Christi report indicated that moisture from Pacific hurricane Naomi contributed to very heavy rain of more than 8 in. that fell in parts of the city on the 14th of the month.

A few stations reported record or near record dryness during September. Savannah, Ga., established a new low rainfall amount this month with only 0.48 in. measured of a normal that exceeds 5 in. New Orleans, La., reported the driest September since 1934—only 1.92 in. of a normal 6.41 in. Greensboro, N.C., received only 0.58 in. of the usual 3.56 in. during September, and Wilmington, N.C., reported 1.24 in. which was 5.05 in. below normal. Several areas in the East have had persistent dryness this year. The Raleigh-Durham Airport in North Carolina reported the lowest January through September total of record. Also Montgomery, Ala., reported the ninth consecutive month with below normal precipitation and a total that is only 57 percent of normal for this period. Erie, Pa.,

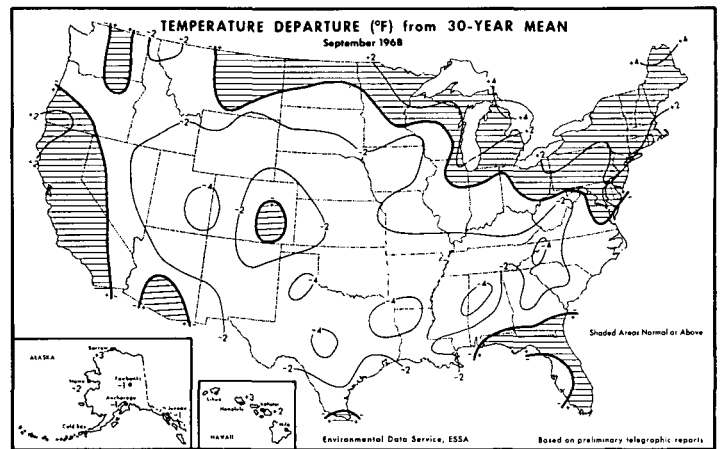


FIGURE 5.—Departure from normal of average surface temperature (°F.) for September 1968 (from [5]).

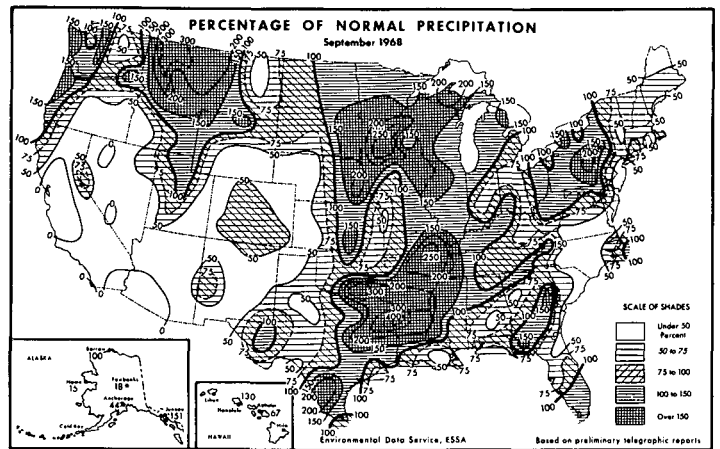


FIGURE 6.—Percentage of normal precipitation for September 1968 (from [5]).

reported the eighth consecutive month with below normal precipitation.

#### 4. VARIATIONS WITHIN THE MONTH

The fairly deep trough in the central part of the United States early in September (fig. 7A) resulted in generally below normal temperatures except near the west and east coasts. In the Plains States underneath strong northwesterly upper level flow and below normal 700-mb. heights (fig. 7B), the coolness was extreme with large areas ranging 6 to 9°F. below normal (fig. 7C). The Far West had rather large positive temperature anomalies caused by subsiding air to the east of the strong eastern Pacific High. Southerly flow to the east of the mean trough and frequent cyclonic activity gave extensive areas of heavy precipitation in the eastern half of the Nation (fig. 7D). The West was generally dry as a result of the subsiding northerly flow. Fairly heavy rain did fall in Montana as a migratory Low moved through the area.

Progression of the long wave pattern brought a ridge to the central United States the second week of September (fig. 8A) and a trough near each coast. Warm air spread eastward with the ridge giving above normal temperatures to the West and most of the northern border States (fig. 8C).

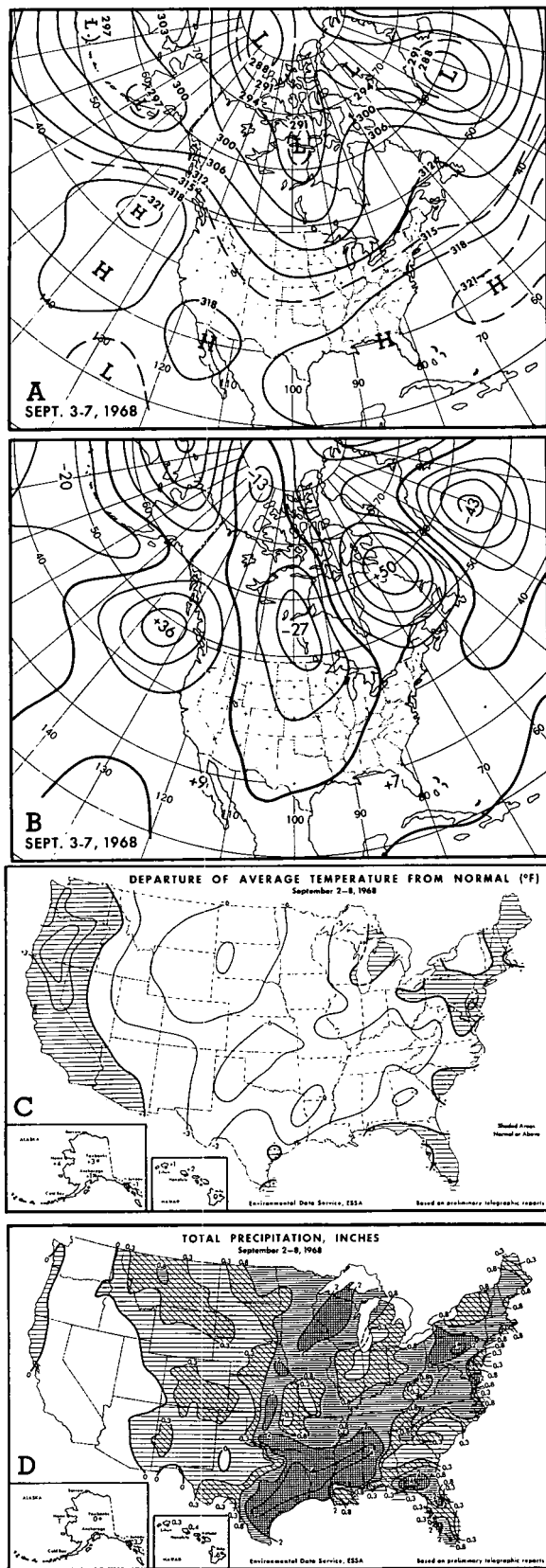


FIGURE 7.—(A) Mean 700-mb. contours (decimeters) and (B) departure from normal (meters) for Sept. 3-7, 1968; (C) departure of average surface temperature from normal (°F.) and total precipitation (inches) for week of Sept. 2-8, 1968 (from [5]).

However, the trough in the East with below normal 700-mb. heights (fig. 8B) and northwesterly flow aloft gave quite cool weather to the Southeast and the South Central States. Subsidence with the advancing ridge

caused drying conditions in much of the Plains with large areas receiving no rain this week (fig. 8D). A middle latitude low pressure system and the associated cold front caused most of the quite heavy rain from the Mississippi Valley eastward. However, some of the rain in the East was produced by a small tropical-like depression that later merged with the storm in the main westerly belt to form an intense Low [4]. The heavy rain along the Pacific Northwest Coast was caused by the anomalously strong southwesterly flow aloft being lifted by the coastal mountain range.

Continued progression the third week of September brought a strong ridge to the East (fig. 9A) which produced an unusually strong positive height anomaly in eastern Canada (fig. 9B). Very warm air moved into the Northeast (fig. 9C) with the ridge and considerable warming occurred in the Southeast, but average temperatures for the week in that area were still only about normal. Since not only the ridge but also the trough that had been in the eastern Pacific advanced, a deep complex trough system moved into the western and central United States. Extensive cool air as much as 9°F. below normal came into the West with the trough. In the Texas and Oklahoma areas temperatures remained above normal even though 700-mb. heights were considerably below normal. Two main factors were involved here—southerly flow in the surface layer most of the week and westerly downslope upper level flow that was slightly anticyclonic.

In the Mississippi Valley where southerly surface flow brought ample moisture from the Gulf of Mexico, the advancing trough caused very heavy rain (fig. 9D) in the same general region that had heavy rain the first week of the month. The amplitude of the flow was much greater this week than during the first week resulting in the heavier rains being spread farther north. Heavy rain in the Far West came early in the week as the trough advanced, and the heavy rain in the Montana area was caused by combination of upslope northerly winds in the surface layer and a developing storm that moved out of the Great Basin area. The Southwest remained dry even with a mean trough over the area owing to the dryness of the air, and most of the East Coast was dry under the effects of the strong upper level ridge.

Progression was still the main feature of the flow across the United States during the last week of the month. A drying and warming ridge returned to the West (fig. 10), while the troughs that had been over the western and central States combined and moved to the East. This trough was not very deep to the south, as 700-mb. heights were near normal over most of the East (fig. 10B). A small strip of above normal temperatures from Colorado to the Ohio Valley persisted as the trough moved through, but in general the northerly flow to the west of the advancing trough brought cool air to most of the central two-thirds of the Country. Southwesterly flow to the east of the mean trough made the East Coast States generally warmer than normal.

Most of the Country had light rain this week because the advancing trough was not deep in the United States. The heavy rain area from central Texas towards the

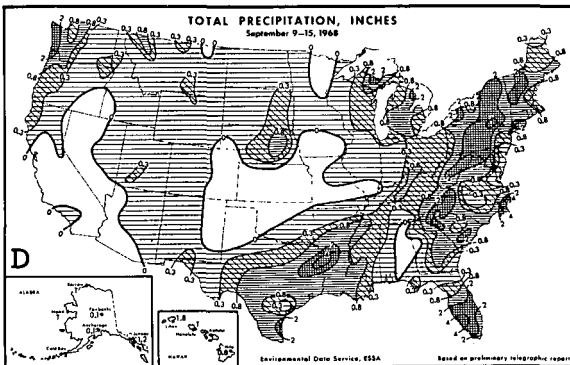
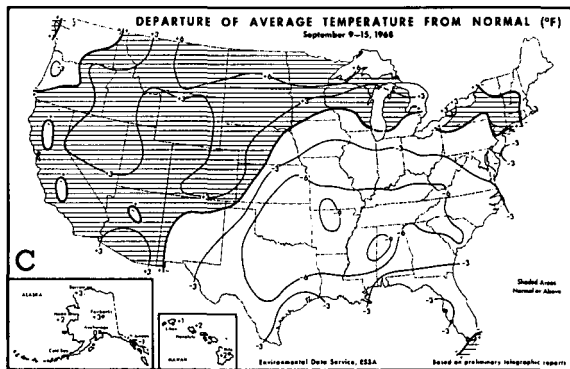
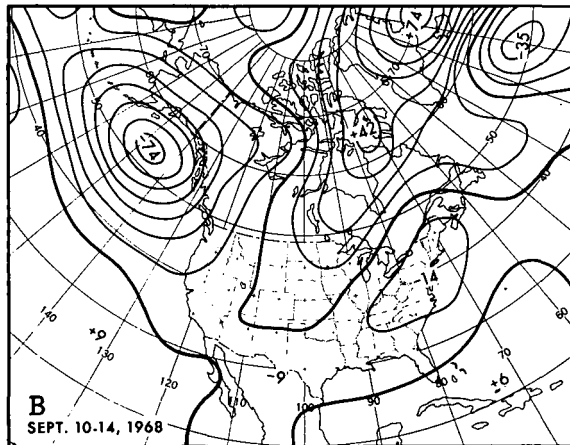
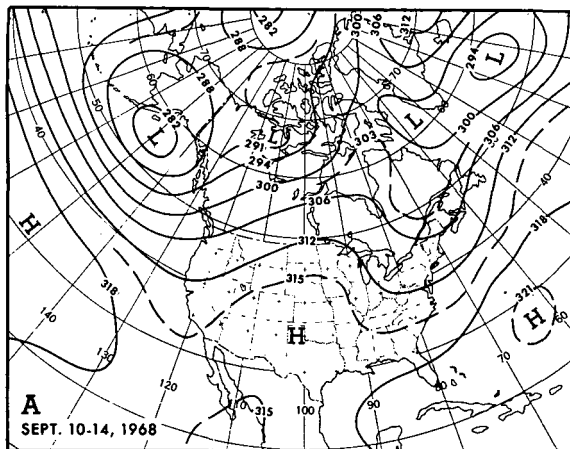


FIGURE 8.—Same as figure 7, (A) and (B) Sept. 10-14, 1968; (C) and (D) for week of Sept. 9-15, 1968 (from [5]).

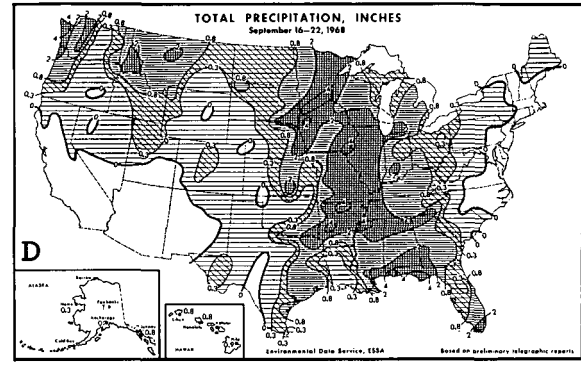
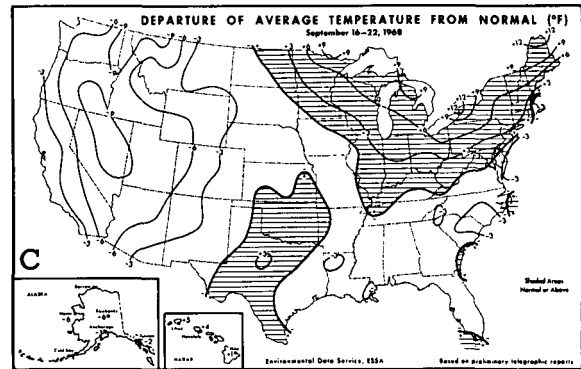
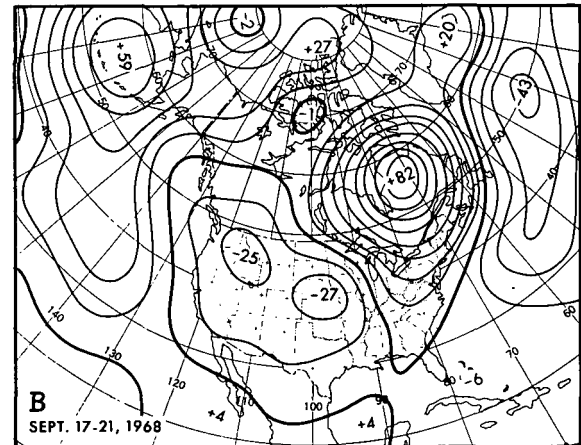
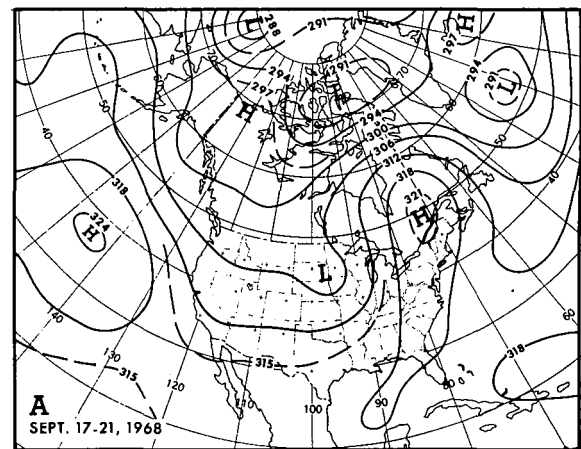


FIGURE 9.—Same as figure 7, (A) and (B) for Sept. 17-21, 1968; (C) and (D) for week of Sept. 16-22, 1968 (from [5]).

Great Lakes occurred with a trailing cold front from a deep Low that moved through southern Canada. The heavy rain in southern Florida was caused by a depression that formed east of the Yucatan Peninsula and moved northeast across Florida.

## 5. TROPICAL STORMS

The rather strong anomalous easterly gradient in both the western and eastern Pacific (fig. 2) was associated with considerable tropical storm activity in those areas

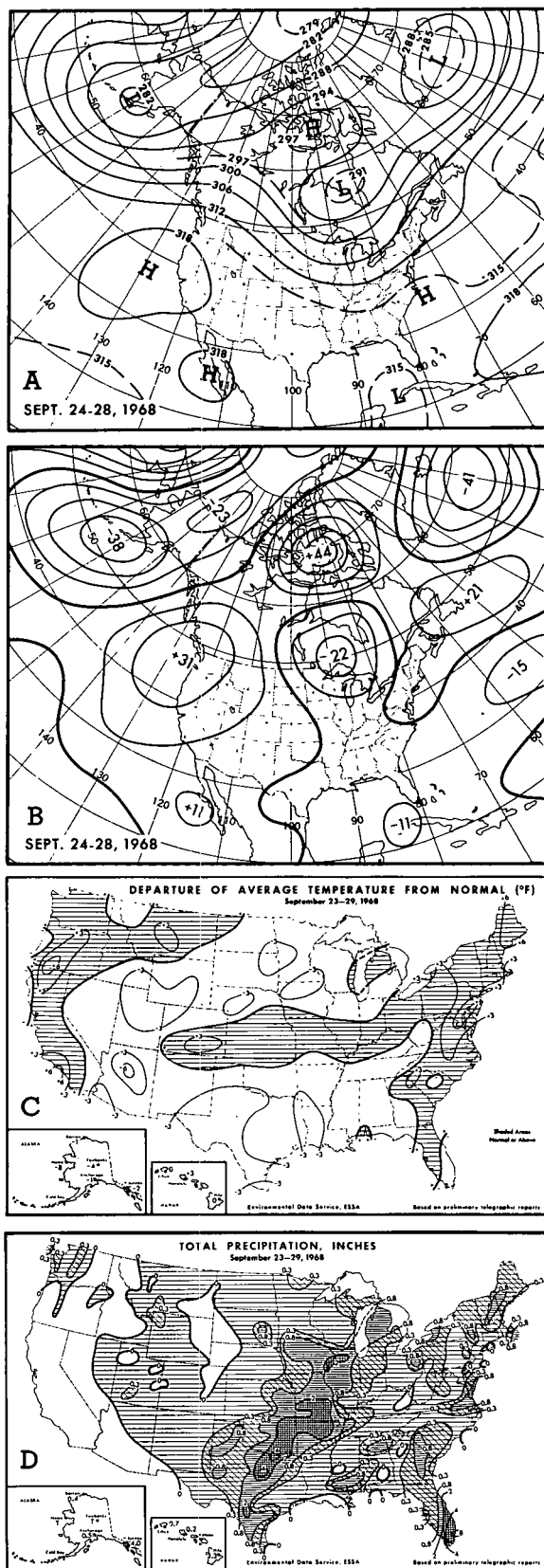


FIGURE 10.—Same as figure 7, (A) and (B) for Sept. 24-28, 1968; (C) and (D) for week of Sept. 23-29, 1968 (from [5]).

during September. Wendy, Agnes, Bess, Carmen, Della, and Elaine in the western Pacific all reached typhoon intensity at some time during the month. Two of these storms moved into Vietnam as they were dissipating. Also, the northern Philippines, Japan, Taiwan, Hainan,

and the Luichow Peninsula received weather that was associated with one of these storms. The details of the point of origin and the tracks of these storms can be seen in the *Mariners Weather Log* [3].

In the eastern Pacific five tropical disturbances were observed during September. These storms were Kathleen, Liza, Naomi, Orla, and Pauline. Only Naomi affected land areas noticeably during the month. Naomi began about the 11th off the west coast of Mexico and south of 20°N. This storm moved mostly north while its winds increased to hurricane force. It moved into Mexico after decreasing to tropical storm intensity and was located about 90 mi. north of Mazatlan, Mexico, at 0600 GMT on the 13th. A satellite picture later during the day seemed to show a cyclonic circulation of clouds well inland over Mexico in a position that would indicate a northeastward motion of the storm. The moisture from this storm contributed to the heavy rains in Texas at that time.

In the presence of either anomalous westerly flow at 700 mb. or an extremely light anomalous component in the lower latitudes of the Atlantic (fig. 2), tropical storm activity there was less than normal. No hurricanes were reported and only two disturbances reached tropical storm intensity. Edna formed in the central Atlantic near midmonth. After attaining wind speeds of 60 to 65 m.p.h., this storm deteriorated to a wave in the easterlies, as it approached the Antilles on the 19th. Frances first formed as a low pressure center near the Bahamas, but this depression did not have significant wind speeds as it drifted northeastward until the 27th when it was given a name and became part of the tropical storm statistics for the Atlantic Ocean. Frances was lost in the westerlies on the 29th without having affected the mainland. Two other low pressure centers that originated over warm subtropical waters caused weather that affected the United States in the East. The first of these, which formed off the Carolina coast on the 10th and seemed to have some tropical characteristics, is discussed in detail in [4]. Another depression formed immediately to the east of the Yucatan Peninsula, moved northeastward across Cuba and southern Florida, and brought heavy rains to those areas during the last days of September. Winds remained fairly light with this depression.

#### REFERENCES

1. J. F. Andrews, "The Weather and Circulation of August 1968—Sharp Contrasts in Temperature and an Unusually Strong Summer Index Cycle," *Monthly Weather Review*, Vol. 96, No. 11, Nov. 1968, pp. 826-832.
2. A. J. Wagner, "The Weather and Circulation of July 1968—Rather Changeable but Predominantly Cool," *Monthly Weather Review*, Vol. 96, No. 10, Oct. 1968, pp. 746-752.
3. Environmental Data Service, ESSA, "Rough Log—North Pacific Weather," *Mariners Weather Log*, Vol. 12, No. 6, Nov. 1968, pp. 209-214.
4. A. J. Wagner, "Picture of the Month—Illustrating the Merger of Tropical and Extratropical Systems," *Monthly Weather Review*, Vol. 96, No. 12, Dec. 1968, pp. 889-893.
5. Environmental Data Service, ESSA, *Weekly Weather and Crop Bulletin*, Vol. 55, No. 37-41, Sept. 9, 16, 23, 30 and Oct. 7, 1968, pp. 1-8.